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THE PRESERVATION OF MINERAL SPECIMENS¹

A. L. PARSONS, *University of Toronto*

A problem which frequently confronts a museum curator is the proper preservation of certain choice specimens of minerals. A long and costly experience has already taught him that if he would preserve crystals of ruby silver, he must keep them in the dark. A less expensive but no less disastrous experience has shown him that realgar is almost invariably ruined when exposed to the light. From other disasters he has also learned that his specimens of carnallite must be kept in a moderately dry atmosphere while certain others are completely destroyed in the same dry atmosphere. In spite of such experiences it is seldom that any special precaution is taken to prevent the destruction of material that has been obtained, often at great risk or great expense. In some cases it is impossible to duplicate the material.

This problem was presented to the writer in a very practical way during the past summer when a considerable quantity of laumontite was collected along the shores of the Bay of Fundy, and it seemed a question whether it could be preserved long enough to make a satisfactory examination of it if it were packed in the ordinary way. It was noticed, however, that with one exception the specimens of fresh laumontite were exposed only below high water so that it was decided to pack the specimens so as to keep them wet. Two kegs were packed, the specimens being wrapped in paper, and in the first keg sawdust was used liberally and when the keg was filled the whole was thoroughly saturated with water before the head was put in. In the second keg, for want of better material, fresh sea-weed was used as the packing material. In the same shipment was a box containing a few specimens of laumontite with

¹ Presented at the meeting of the Mineralogical Society of America, December 29, 1921.

which no special precautions were taken. Directions were forwarded to the museum that as soon as this shipment arrived an auger hole was to be bored in the head of each keg and a pint of water poured in each day. Before unpacking a number of glass jars were secured so that if the specimens were in good condition they could be preserved at once from any danger of the usual decomposition. When the material was unpacked it was found that the laumontite in the box had become white and chalky in appearance like most museum specimens of this mineral. The specimens in the kegs, however, were bright and showed no sign of disintegration. While both kegs of specimens were equally well preserved it was found that there is considerable difference in the desirability of the two packing materials. In the three months that intervened between packing and unpacking, the sea-weed had decayed and shrunk so that the keg was no longer full and for long journeys it would be utterly unsuitable as there would be grave danger that the specimens would be destroyed when some freight handler should roll the keg after the shrinkage had begun. In the case of the sawdust there was no shrinkage. In packing minerals wet it is necessary, in case there is not sufficient material from a single locality to fill a keg, to pack the specimens from each locality in a cloth bag, which can be identified, before putting in the keg, as all paper labels will be destroyed.

For such minerals as this it is desirable that a method be devised whereby they may be exhibited safely and conveniently. A museum jar with plane surfaces provides a receptacle in which the material may be preserved in water and in most cases even the transparent colorless minerals will remain visible because of their higher index of refraction. If the minerals were in an atmosphere saturated with moisture the same result, so far as the preservation of the specimen is concerned, would be attained, but the condensation of moisture on the walls of the cell would at times offer an impediment to easy vision. If the first method be used it is necessary to avoid the use of organic material as a support as bacterial growths soon appear under certain conditions.

The single specimen of laumontite that was found above high tide offers a possible solution to the problem. This specimen was in a dry cavity facing the north or north-west in such a way that the specimen was at all times protected from the sun's rays. The

temperature probably never exceeded 55° Fahr. A room that never has a temperature greater than 55° Fahr. nor less than 33° Fahr. should provide conditions that would preserve nearly all minerals that suffer damage by loss of water.

The reverse problem is presented by such minerals as carnallite and other deliquescent chlorides. In this case the museum jar again offers a solution to the problem, but the specimen must be in a dry atmosphere or in some liquid from which the mineral cannot absorb water. In this case as in the last the stability of the mineral depends not only on the relative humidity of the atmosphere but on temperature.

A similar problem is presented by those minerals that melt at a comparatively low temperature. These rarely give cause for anxiety except in tropical climates, yet during the past summer a jar of mirabilite in the Royal Ontario Museum of Mineralogy melted in part, thus showing another type of material that should be preserved at a low temperature. Although few minerals actually melt in the temperature of a museum even in the tropics there are many particularly among the sulfides that oxidize under such conditions. The fumes evolved by a carload of pyrite on a hot summer day give undoubted evidence of oxidation which should be a reason for considering the temperature and light conditions that are necessary to preserve the sulfides. How far high temperature is responsible for the compounds that give rise to the beautiful tarnish on many minerals is a subject for careful investigation.

While high temperatures are in many cases disastrous, low temperatures may be equally injurious. Many a specimen containing liquid inclusions ceases to be an object of peculiar interest when the temperature has gone below the freezing point of the liquid.

It is of course evident to all that sulfur fumes and other active gases should not be permitted to invade a museum, particularly where it is desirable to preserve silver specimens. The brown and finally black tarnish that appears gives serious cause of mourning.

Light is one of the most serious problems. To the writer it is somewhat doubtful whether any mineral remains in its original condition after long exposure to light. The experience with the transparent silver compounds leaves little doubt that they are all eventually injured by light. A similar statement may be made for realgar and kermesite and some varieties of topaz. In the case

of certain minerals exposed to the light of some of the newer electric lamps a beautiful fluorescence is frequently observed. In view of the changes in color that have been produced by ultra-violet rays, X-rays and radium emanation it is by no means improbable that serious color changes are brought about slowly by other light waves. The problem becomes more complex when we try to store radio-active minerals with those that are noticeably sensitive to radio-activity.

It may be argued that if it is necessary to keep minerals in the dark it will be impossible to have a public museum. It must be remembered, however, that a museum of mineralogy is not primarily a place for display but a laboratory and store-house where investigations go on and material is preserved for future research. If material cannot be displayed without being ruined it is the curator's duty to see that the specimens shall only be viewed under conditions that will ensure their preservation. No one with the simplest knowledge of photographic chemistry would dream of opening a box of dry plates in broad daylight. Why then should the museum curator display cerargyrite to the public? The only excuse is that the specimens are all ruined before they reach a museum. If we look upon the prime object of a museum to be not display but preservation of priceless material it then becomes possible to outline conditions for attaining our object. If we know the conditions under which minerals are formed and can duplicate those conditions we can be certain that in most cases the mineral can be preserved. With increased knowledge of the vapor pressure of minerals it will be possible to provide conditions under which they will remain stable.

It is not the intention of the writer to indicate the conditions for the preservation of all minerals. If, however, he can stimulate a study of these conditions so that at some time he may see well-preserved crystals of the sulfates of iron without having the drip of mine water about him he would feel that a decided advance in museum methods had been made.

The following lists include some of the minerals that are injured to some extent by the causes indicated:

LOSS OF WATER

Quartz (fluid cavities)

Halite (fluid cavities)

Natron

Pirssonite

Gaylussite

Lanthanite (?)

Trona

Hydromagnesite

Lansfordite

Laumontite

Borax

Epsomite

Goslarite

Morenosite

Boothite

Melanterite

Chalcanthite

EXPOSURE TO LIGHT

Realgar

Pyrargyrite

Proustite

Pyrostilpnite

Tetrahedrite (?)

Xanthoconite

Cerargyrite

Embolite

Bromyrite

Iodobromite

Iodyrite

Huantajayite

Amethyst ?

Smoky quartz

Rose quartz

Topaz

ABSORPTION OF

WATER

Halite

Huantajayite

Hydrophilite

Chloromagnesite

Lawrencite

Scacchite

Molysite

Bischofite

Kremersite

Erythrosiderite

Douglasite

Carnallite

Tachyhydrite

Soda Niter

Niter

Nitrocalcite

Nitromagnesite

Nitrobarite

Gerhardtite

Darapskite

Nitroglauiberite

Kainite

Nesquehonite

Thermonatrite

Melanterite

EXPOSURE TO RADIO-VOLATILIZATION

ACTIVITY

Diamond

Spodumene

OXIDATION

Alabandite

Polydymite

Marcasite

Vivianite

TARNISH (IN PART BY

OXIDATION)

Arsenic

Bismuth

Silver

Copper

Lead

Iron

Stibnite

Bismuthinite

Dyscrasite

Domeykite

Temiskamite

Chalcocite

Pyrrhotite

Bornite

Chalcopyrite

Stannite

Smaltite

Cobaltite

Gersdorffite

Berthierite

Enargite

RAPID CHANGE IN

TEMPERATURE

Sulphur

VOLATILIZATION

Sal-Ammoniac

Teschemacherite

MELTS AT LOW TEM-

PERATURES

Mirabilite

TWO CORRECTIONS TO MINERAL DATA¹N. L. BOWEN, *Geophysical Laboratory, Carnegie Institution of Washington*

RIVAITE AND REAUMURITE

Some time ago Professor A. B. Peck showed me some crystals in a partially devitrified glass and though their optical properties were readily determinable we were unable to identify the crystals with any known compound. Suspecting that they might be "rivaite," a supposed disilicate of sodium and calcium found at Vesuvius, I sent to Professor Zambonini for a specimen of that mineral in order that I might measure its constants. Professor Zambonini kindly sent a specimen which proved on examination to consist of minute needles of wollastonite embedded in glass of refractive index varying from about 1.51 to 1.52. The microscopic appearance was exactly that of a devitrified crown glass such as is frequently encountered in glass practice.²

In his recent bulletin giving his determinations of optical constants Larsen has included rivaite. He, too, notes its inhomogeneity, stating that it consists of "two minerals in approximately equal amounts. One of these minerals is clear and isotropic and has an index of refraction of 1.513 ± 0.003 . The other occurs in prisms embedded in the isotropic part."³ He then gives the properties of these prisms in detail and remarks that these properties are not very different from those of wollastonite.

In Table 1 it is shown that the differences are, indeed, within the limits of error of the measurement when the comparison is made with pure synthetic wollastonite.

TABLE 1

	γ	β	α
Pure synthetic wollastonite.....	1.631	1.629	1.616 ⁴
Prisms in "rivaite".....	1.628	1.627	1.614 ⁵

¹ Presented at the meeting of the Mineralogical Society of America, December 29, 1921.

N. L. Bowen. The identification of "stones" in glass. *J. Am. Ceram. Soc.*, **1**, 4-605, 1918.

E. S. Larsen, *U. S. Geol. Survey, Bull.* **679**, 127, 1921. In the index it is given as Rivaite (doubtful)."

⁴ Refractive indices as determined by F. E. Wright. *Am. Jour. Sci.*, **39**, 74, 1915.

⁵ Refractive indices as determined by Larsen. *loc. cit.* The uniformly lower values found for "rivaite" may possibly represent a real difference, in which case they are to be referred to a very small amount of another compound, say Na_2SiO_3 , in solid solution. If this is true the crystals vary towards a wollastonite-pectolite.

These prisms of "rivaite," according to previous observers, have positive elongation, but by careful rolling of the prisms in liquid a position can be found in which the elongation is negative though the birefringence is then excessively weak. The elongation is therefore β and the difficulty of finding a section with negative elongation is due only to the fact that β and γ are nearly identical, and the range of positions showing negative elongation is, therefore, very narrowly restricted. The similarity to wollastonite is complete.

The mineral rivaite should, therefore, not be accepted as an established species. The material called by that name is inhomogeneous and consists of prisms of wollastonite embedded in glass. It is evidently a piece of cobalt-bearing glass that has become involved with volcanic material and devitrified as a result of the heating it experienced.

Lacroix describes such devitrified glass from Mont Pelée and, comparing it with rivaite, comes to the conclusion that this Vesuvian material is also devitrified glass. But Lacroix considers that in both localities the glass as a whole has devitrified and given a mineral that has sensibly the same composition as the glass. This is certainly not true of the Vesuvian material. To the material from Mont Pelée, Lacroix gives the definite mineral name, reaumurite, but states that it is probably identical with rivaite. It seems quite possible that reaumurite is a mixture of glass and wollastonite differing only from rivaite in being of finer grain.⁶ The given properties of reaumurite suggest, too, that it may vary more decisively toward wollastonite-pectolite, than does rivaite.

(Since the above was written, Professor Zambonini has kindly sent me a sample of a synthetic preparation made by him at the Geophysical Laboratory while visiting here some years ago. A glass was made by fusing Na_2CO_3 , CaCO_3 , and SiO_2 in the proper proportions to give the composition $(\text{Na}_2, \text{Ca}) \text{Si}_2\text{O}_5$. (The ratio $\text{Na}_2\text{O} : \text{CaO}$ in this synthetic material is not stated by Professor Zambonini.) This glass was then devitrified at a low temperature. The product is not altogether homogeneous but appears to consist almost entirely of crystals of one kind. The composition of the crystals can not be far from the total composition of the mixture so that this synthetic material proves the possibility of the existence of crystals which at least approach the composition that has been

⁶ *Bull. Soc. Min. France*, **38**, 16-21, 1915

assigned to rivaite. The properties of these crystals are, however, altogether distinct from those of the crystals contained in the inhomogeneous material that has come to Larsen and to me as rivaite. The synthetic crystals have parallel extinction, positive elongation and γ about 1.58. These properties correspond very well with those of the crystals originally sent me by Professor Peck. The possibility that a glass, when subjected to volcanic heat, might be devitrified in such a way as to give these crystals must therefore be accepted, but the material called rivaite, as now available, does not correspond with them. Even though some of the specimens of rivaite or reaumurite should be definitely shown to contain crystals corresponding with Zambonini's synthetic crystals, it is doubtful whether material formed in the manner of these specimens can be appropriately set up as a mineral species.)

MONTICELLITE

Our knowledge of the optical constants of natural monticellite is based entirely on the crystals from Magnet Cove. Of these the optic axial angle $2V$ as determined by Penfield and Forbes⁷ is $75^{\circ} 02'$, but all text-books give $37^{\circ} 31'$, which is really the value of V . The Magnet Cove monticellite therefore has a large, instead of a small, optic axial angle. We have not sufficient data to be sure of the variation of optical constants with composition, but we have certain indications bearing on the question. Artificial monticellite of the theoretical composition is positive, with $2V$ nearly 90° .⁸ The Magnet Cove mineral is negative, with $2V$ as given above, and contains 4.75 per cent FeO and 1.62 per cent MnO. All monticellites intermediate between these two in composition will probably be intermediate in properties, since the actual range is quite small. A monticellite with from 1.5 to 2 per cent FeO would probably have $2V$ about 90° and therefore lie on the border between positive and negative monticellites. The optic axial angle of all of them would be large and of most of them very large. With these data in mind it seems probable that the "mineral A," associated with the merwinite of Larsen and Foshag,⁹ is monticellite.

⁷ *Am. Jour. Sci.* 1, 135, 1896.

⁸ See Merwin in Ferguson and Merwin, The ternary system CaO-MgO-SiO_2 , *Am. Jour. Sci.* 48, 92, 1919.

⁹ *Am. Min.* 6, 144, 1921.

A PLEA FOR ECONOMIC MINERALOGY¹

OLIVER BOWLES, *Bureau of Mines, Washington, D. C.*

The study of mineralogy and crystallography affords a mental discipline, and a training in scientific endeavor that is to be excelled by few, if any, of the natural sciences. No one can question the importance of the position that these subjects hold in the realm of pure science, and no true mineralogist desires to see any tendency toward a recession from the influential position they now maintain in the world of scientific thought. The names of many eminent scientists whose work is historic, and whose influence is perpetual, are linked inseparably with mineralogy, and the expectation is that many other mineralogists, now active in the field of research, and still others who are yet to come will join the ranks of the immortals.

In making a plea for economic mineralogy there is no thought, therefore, of urging the commercialization of a pure science, or in detracting in any way from its value as an avenue of research, for unfolding new and valuable truths that may be added to the sum of human knowledge. The purpose is rather to urge upon teachers of mineralogy that while they lead their students across the threshold of this branch of science, and direct their thought toward the well-defined, though possibly tortuous path of scientific attainment, they at the same time supplement the purely scientific thought with certain economic aspects of mineralogy that are in many instances sadly neglected.

In this age, even the pure scientist cannot fail to be impressed with the fact that all commerce and industry are based on natural resources, and that the practical aspects of these resources should be more generally understood.

It is recognized of course that economic phases of metallic ore deposits are covered more or less completely in courses on economic geology, but in such courses the discussion of the minerals themselves is usually buried beneath a mass of information on the geology and geography of ore deposits. Furthermore, economic geology is a specialized course, and thus students other than specialists are for the most part deprived of this possible avenue of information.

¹ Published by permission of the director of the Bureau of Mines. Presented at the meeting of the Mineralogical Society of America, December 29, 1921.

Books on economic geology are numerous, but economic mineralogy is not so favored. It is encouraging, therefore, to note the recent appearance of a book entitled "Economic Mineralogy" by Thomas Crook of London. Its tendency is to encourage study of the phases of mineralogy emphasized in this paper. While there is room for considerable improvement in its mode of treatment, particularly in its classification into ore minerals, gem minerals, and miscellaneous economic minerals, it is nevertheless a welcome addition to the list of available books on mineralogy.

The writer taught mineralogy and crystallography for a number of years, and subsequently devoted close study to purely economic problems in mining and mineral utilization. An unusual advantage has therefore been afforded to view both aspects of the question, and in looking in retrospect over his academic work, the writer is impressed with a keen realization that emphasis was placed on the mineral occurrences which were best adapted for morphological or chemical study, with consequent neglect of the economic occurrences. It is possible that a careful and unbiased scrutiny would disclose similar tendencies in the work of many other teachers of mineralogy.

A few practical examples will better illustrate the condition which the writer deplors. In introducing students to the mineral calcite, the specimens presented for examination usually consist of transparent cleavage fragments of Iceland spar, together with incrustations of crystal aggregates. If undue emphasis is placed on such specimens the student fails to grasp the fact that Iceland spar and calcite crystals are of negligible importance commercially while limestone and marble, the common forms that occur in nature, are mined to the extent of approximately 55 million dollars each year.

When the subject of gypsum is under discussion, the favorite specimen for illustrative purposes is the swallow-tail twin, while the commercial type of granular or massive gypsum may be given minor attention.

Fluorspar in beautiful purple cubes illustrating interpenetration twins is an attractive hand specimen that never fails to arouse interest and even wonder, but how many lecturers pass around specimens of the commercial gravel spar, which is no more interesting in appearance than any ordinary gravel, and how many of them emphasize the fact that gravel spar is mined to the extent

of thousands of tons every year, while the crystals are of comparatively rare occurrence?

Apatite is usually shown in hexagonal prisms, and in crystalline masses, forms which have little or no commercial importance. Phosphate rock, the commercial type, which bears the same relation to apatite that limestone does to calcite, is commonly not even mentioned.

Other minerals the crystallized forms of which are in many instances allowed to gain undue prominence in the student's mind are garnet, pyrite and quartz.

Most text-books classify minerals on a chemical basis, and while this is justifiable, such a classification throws abundant and rare minerals into the same groups, and tends to confuse the student as to their relative importance. Thus in Dana's System of Mineralogy, more space is given to sternbergite than to chalcocite. Furthermore, of the minerals that are abundant the space devoted to descriptive matter may mislead students as to their relative value. For example in the text to which reference is made above the valuable mineral kaolinite occupies 3 pages, and the practically worthless epidote 5 pages.

From a chemical, physical and morphological standpoint such apparently disproportionate discussion may be fully justified, but if the student is to maintain a well-balanced concept of relative values, some effort should be made to emphasize the economic importance of all minerals studied.

The suggestion is therefore offered that all teachers of mineralogy endeavor to present the subject in such a way that the student will gain a clear idea of the relative economic value of various minerals, that he will not overestimate the importance of crystallized forms, and that he will become familiar with the commercial types.

BOOK REVIEWS

THE MICROSCOPIC DETERMINATION OF THE NONOPAQUE MINERALS. ESPER S. LARSEN. 294 pages. U. S. Geological Survey *Bulletin* 679, Washington, 1921. (Obtainable from the Superintendent of Documents, Washington, D. C., for 30 cents.)

Tables for the identification of minerals by the immersion method under the petrographic microscope have been available for some years, but they have covered only the commoner minerals, and some of the data have been inaccurate or contradictory. Realizing the usefulness of this method, Dr. Larsen set out to collect more complete information, not only checking previous work in doubtful cases, but

actually determining the chief optical constants of over 500 species never before so studied. As a result of this splendid piece of work, he estimates that there remain optically unknown not more than 30 of the very rarest minerals, which were not represented in any of the collections accessible to him—not even in Colonel Washington A. Roebling's. In presenting the results, he points out the need for further work, however, especially the determination of optical data on crystallographically and chemically characterized material.

The methods used in determining optical constants are described in a 20 page chapter. These are in general those described in standard works, altho some practical hints from the author's experience are given, and new immersion media suggested, especially for the highest and lowest indices. There is also a brief statistical treatment of the distribution of intermediate index and double refraction, with a table of the "specific refractive energies" of the chief constituents of minerals. Incidental results of the study are the demonstration of the distinctness of certain supposed varietal minerals, as priceite, lithargite, and secondary allanite, while others supposed to be distinct are shown to be identical, notably mazapilite and arseniosiderite, liebigite and uranothallite, and bementite and caryopillite.¹ The author's personal measurements, covering hundreds of species, require 125 pages for presentation, and a like space is devoted to the tabulations.

The principal tables are divided into the optical groups, isotropic, uniaxial positive and negative, and biaxial positive and negative; and the minerals are arranged in these groups in the order of increasing index- n . Successive columns contain: The index; the name and formula of the mineral, formulas being given in expanded form, thus avoiding controversy as to constitution; $2V$ and dispersion; optical orientation; the crystal system and habit; cleavage; color; hardness and specific gravity; and remarks.

The mere mention of these features is sufficient to demonstrate the great value of the work. A few minor criticisms suggest themselves. The discussion of the principles of crystal optics is somewhat confused, the term "embedding" is substituted for "immersion" now and then in a rather puzzling way, the list of immersion media does not include such useful liquids as monochloronaphthalene ("Halowax"), and the discussion of the relation between refractive index and chemical composition is not as full as it might be. Altho it is pointed out in two places that many of the minerals are variable in composition and accordingly in optical properties, this fact is easily lost sight of in the tables. After a worker determines a set of indices with care, he is likely to be impressed with the exactness of his data, and then, on not finding anything in the tables that corresponds very closely, or even (apparently) rather remotely, he may conclude that he has discovered a new mineral. This danger might have been lessened by stating at least three sets of index values for each of the more variable minerals—two extremes and a mean—and inserting a downward pointing arrow (or dagger) beside the low values, a double pointed one beside the mean ones, and an upward pointed symbol of like kind beside the high values. Moreover, when a mineral varies from $+$ to $-$, some other symbol should have been introduced to call attention to the fact.

On the whole, however, the work is highly praiseworthy. There are fewer typographical errors than would have been expected in such technical matter, and

¹ Nomenclatorial changes not already noted in this magazine will be discussed in our new minerals column.

the mineralogical data give evidence of great care in compilation. "Larsen's Tables" are likely to remain the last word on the subject for a long time to come.

EDGAR T. WHERRY.

DANA'S TEXT-BOOK OF MINERALOGY. 3rd edition, revised by WILLIAM E. FORD. New York: John Wiley and Sons, Inc. 8vo, 720 pages. \$5.00.

The preface to this welcome new edition of the well known Text-Book announces that the changes involved are chiefly those of addition, altho much of the description of optical characters of minerals and of drawing crystals has been rewritten to bring them into accord with modern developments.

In part I, Crystallography, the diagrams of the various crystals and projections are now plainly labeled as to either mineral represented or forms shown, so that it is no longer necessary to search for reference to a figure somewhere in the text. In cases where the clinographic projection does not clearly show the complete habit and symmetry of the crystal, orthographic plan-views are added. In the discussions of the calculations in the several systems, the use of the stereographic and gnomonic projections is introduced, with the aid of actual examples. Two-circle goniometry, and Professor Victor Goldschmidt's methods, are briefly but cordially described.

In part II, Physical Mineralogy, methods, apparatus, and literature references are brought up to date. The rewritten discussion of optical properties and their determination brings the subject into accord with modern practice. Part III, Chemical Mineralogy, has not, however, been changed enough to make it appear modern. It still records the number of chemical elements as 80; bismuth, gallium, silicon and some rare earth metals retain long discredited atomic weights; columbium masquerades as niobium; the misspelling of Avogadro's name is copied from the previous edition; while ionization (and its bearing on reactions and formulas) is not mentioned. The "Table of Periodic System" given is particularly disappointing,—several elements, including noble gases, being omitted, and nothing being mentioned as to atomic number or other modern developments. There is a paragraph on colloidal minerals, but it is hardly adequate.

In Part IV, Descriptive Mineralogy, there has wisely been no attempt to change essentially the arrangement of species, since the time for changes will be the preparation of a new edition of Dana's System. However, numerous recently described minerals, mineraloids, and mixtures have been introduced at various points, so that the book now represents a fairly complete record of the known and alleged mineral species. Other valuable additions are the paragraphs headed "Micro.," just after the older "Pyr, etc.," in which mineragraphic data are given for opaque minerals, and petrographic data for transparent ones; and the refractive indices of a considerable number of species.

In the introduction of new minerals some effort has been made to indicate their rank by the type used, species names being printed in bold face, and varieties or uncertain substances in small capitals. However, the judgment of the author and of the reviewer are not always in agreement as to the rank to be assigned (nor as to the proper location in the sequence). For instance villamaninite, sanguinite and xanthonite are made species, altho their original descriptions seem insufficient to justify this; while cryolithionite, cristobalite, and priceite, in spite of essential differences in crystallization from the nearest important species, are made varieties.

Some old errors in formulas of minerals are repeated, as Ag_6Bi for chilenite, $\text{Cu}_8\text{Sb}_2\text{S}_7$ for tetrahedrite, and a carbonate-free composition for hydrotalcite.

Appendix A, on crystal drawing, is greatly improved by the introduction of Penfield's and Goldschmidt's methods. Appendix B now includes a table of "minerals arranged according to chemical composition" in which are given lists of minerals containing each basic element, arranged in the order used in the body of the work. It is rather difficult to find any particular mineral in these lists, and horizontal lines separating oxides from carbonates, carbonates from silicates, anhydrous from hydrous silicates, etc., might well be added to help out in this respect.

The make-up of the book is good. There are a few compositors' errors, but mostly of an inconspicuous nature, as for instance phrenacite (p. 211), itano-silicates (583) and rutite (676). This journal is not indicated as continuing on page 4 (a dash should follow the date). On the whole this new edition of Dana's Text-Book is a decided improvement on the preceding one. W.

PROCEEDINGS OF SOCIETIES

NEW YORK MINERALOGICAL CLUB

Regular Monthly Meeting of January 18, 1922

The regular monthly meeting of the New York Mineralogical Club was held in the American Museum of Natural History on the evening of January 18th, at 8:15 P. M. The President, Dr. George F. Kunz, presided and there was an attendance of 20 members. The name of Mr. Rodney B. Miller of Newark was submitted to the Committee on Membership by Mr. Broadwell. The committee on summer excursions reported progress.

Madam Arctowski, of the University of London, was introduced by the President and spoke on the vital educational needs of Poland since the War. She spoke on the scarcity of laboratory platinum, of the lack of reference literature and collections, and appealed to the Club for collections of minerals for Lemberg University. Contributions of mineral specimens from members of the Club may be sent through the Secretary to the Society of Science in care of Prof. Twbett, Warsaw, Poland.

Dr. Kunz showed several new publications including the new edition of Dana's Text-Book. He also exhibited some quartz crystals showing inclusions and embedded in sand rock.

The program for the evening consisted of "A symposium on the zeolitic and associated minerals of New Jersey." Mr. Manchester showed a number of fine lantern slides of the excavations of the Erie cut and some exceptional specimens obtained from that locality. Pectolite, cemented and pseudomorphed by quartz, also chabazite and analcite from Weehawken were exhibited by Mr. Ashby. Mr. Wintringham called attention to the recent work on the Microscopic Determination of Nonopaque Minerals, by Dr. Esper S. Larsen of Washington. Mr. Broadwell showed polished pectolite from Paterson and calcite coated on the rhombohedral planes (02 $\bar{1}$). Mr. Maynard exhibited zeolites from Golden, Colo. and compared them with the New Jersey zeolites.

Mr. F. I. Allen called attention to the ditetragonal prisms on apophyllite from Paterson and stated that the interest of this crystal form was often disregarded. He also mentioned the "build up edges" around the termination of the West

Paterson calcite crystals and the twinning of natrolite on the vertical axis as a twinning axis.

On the matter of a subject for the next meeting being brought up by the Chair, it was decided to invite Dr. Larsen to speak on "The Microscopic Determination of Nonopaque Minerals" at the February or March Meeting.

Dr. Kunz read a letter from Professor Dana appealing for funds for the relief of Professor Tschermak and Mm. Bermuth. On the question of a joint meeting with the Newark Club being introduced by Mr. Broadwell, the Secretary moved that the Newark Club be invited to meet with the New York Club on the occasion of Dr. Larsen's address. The meeting then adjourned.

HERBERT P. WHITLOCK, *Recording Secretary*.

PHILADELPHIA MINERALOGICAL SOCIETY

Academy of Natural Sciences, February 9, 1922

A stated meeting of the Philadelphia Mineralogical Society was held on the above date with the president, Mr. Trudell, in the chair. Nineteen members and ten visitors were present. Mr. John Frankenfield was appointed secretary pro tem.

Mr. Samuel G. Gordon gave an interesting account of his trip to South America in 1921, in which the principal localities of Ecuador, Peru, Bolivia, and Chile were visited. The talk was illustrated with 125 lantern slides among which were many splendid photographs of magnificent mountain scenery showing immense glaciers, snow-capped peaks, and some of the loftiest volcanoes in South America. Views of interesting cities, Inca ruins, palm shaded plazas, and Indians, and a large collection of rare and beautiful mineral specimens raised the enthusiasm of all present. A vote of thanks was extended to the speaker.

During the discussion which followed, Mr. George Vaux, Jr. gave some interesting facts concerning the new use of germanium in medicine as an erythropoietic, and Mr. H. R. Blank gave an account of his investigations of this element.

Messrs. Bernard McQue and Horace R. Blank were proposed for active membership.

JOHN FRANKENFIELD, *Secretary pro tem*.

NEW MINERALS

ABSTRACTOR'S NOTE: In recording the data upon new minerals we have stressed heretofore the color and other physical properties, since these are the ones that first attract attention upon examining a specimen. It has seemed, however, that as the primary use of these records will be for purposes of classification, it may be preferable to make chemical properties the primary basis of all mineral classification, and crystallographic properties the secondary basis. By way of experiment this will be tried during the coming year, and comments by readers as to the relative desirability of these or of other possible plans will be looked for.

To further extend the classificatory usefulness of the records, it is proposed also to add after the "family" heading (i.e., oxides, silicates, phosphates, etc.) the "division" ratio of essential constituents of each mineral. This will be given in the form $R'R''R''':R''''$, the R standing for any element other than oxygen, the introduction of the appropriate number of O's each time seeming an unnecessary complication. The superscript accents (') refer to the "positive valence" usually exhibited by the elements concerned, as determined in solutions; the number of attraction directions shown by the same elements as they exist in the crystal structure may be from two to twelve times as great.

E. T. W.

NEW SPECIES

FAMILY: SULFATES. DIVISION: $R'' : R'''' : H_2O = 1 : 1 : 7$.**Zinc-copper-melanterite.**

ESPER S. LARSEN AND M. L. GLENN: Some minerals of the melanterite and chalcantite groups with optical data on the hydrous sulfates of manganese and cobalt. *Am. J. Sci.* **50**, 225-233, 1920; this mineral, p. 225.

NAME: From the composition, containing much *zinc* and less *copper* replacing the iron in a *melanterite*, $Fe [7H_2O] SO_4$.

CHEMICAL PROPERTIES: *Formula*: $(Zn, Cu, Fe)O : SO_3 : 7H_2O$ or $(Zn, Cu, Fe) [7H_2O] SO_4$. (The water of crystallization is placed in brackets next to the metal in accordance with Werner's coordination principle.) Ratio Zn: Cu: Fe=100: 98: 19. (The Fe may be disregarded). An analysis gave: ZnO 12.89, CuO 12.37, FeO 2.14, SO_3 28.78, H_2O 42.61, insol. 1.11, sum 99.90%. These are close to the theoretical values, except that the water is somewhat low, owing to partial dehydration. Before the blowpipe it fuses readily with intumescence to a white froth which turns black; on rapid heating it decrepitates and colors the flame green. Readily soluble in water.

CRYSTALLOGRAPHIC AND OPTICAL PROPERTIES: System monoclinic; only known in columnar-massive forms. Under the microscope it shows pale blue-green rods, not sensibly pleochroic. Refractive indices: $\alpha=1.479$, $\beta=1.483$, $\gamma=1.488$, $\gamma-\alpha=0.009$, all ± 0.001 . Biaxial with sign + and 2 V near 90° . Shows inclined extinction up to 34° . Dispersion slight.

PHYSICAL PROPERTIES: Color pale greenish blue (Ridgway 43 d). Luster vitreous. H.=2. Sp. gr. 2.02.

OCCURRENCE: In large amount as a secondary mineral on the dumps of mines at Vulcan, Gunnison Co., Colorado, formed by the oxidation of an intimate mixture of pyrite, chalcopyrite and sphalerite.

DISCUSSION: Fits well into the group comprising melanterite, pisanite, etc.

E. T. W.

NEW CO-SPECIES¹FAMILY: SULFATES. DIVISION: $R'' : R'''' : H_2O = 1 : 1 : 5$.**Zinc-copper-chalcantite.**

LARSEN AND GLENN, *op. cit.*, p. 228.

NAME: From the composition, containing *zinc* partially replacing the *copper* in *chalcantite*, $Cu [5H_2O] SO_4$.

CHEMICAL PROPERTIES: *Formula*: Essentially $(Zn, Cu)O : SO_3 : 5H_2O$ or $(Zn, Cu) [5H_2O] SO_4$. Constituents except water as in zinc-copper-melanterite. H_2O found, 35.0%; theory for 5 mols., 36.1%.

¹ The term "co-species" is here suggested for minerals formed naturally, yet subsequent to the intervention of man. In the present instances, the bringing of the highly hydrated sulfate minerals into the dry air of a building results in the spontaneous loss of part of the water. Other illustrations are the lead minerals formed by the action of sea water on the slags of the Laurium furnaces, and materials like Lacroix's "reaumurite," produced by volcanic heat from artificial glasses. Suggestions of a better term will be welcome.

CRYSTALLOGRAPHIC AND OPTICAL PROPERTIES: System triclinic. Under the microscope finely crystalline and pale blue. $\alpha=1.513$, $\beta=1.533$, $\gamma=1.540$, $\gamma-\alpha=0.027$, all ± 0.003 . Biaxial with 2V moderate and sign —.

PHYSICAL PROPERTIES: Color pale blue. Structure, a fine aggregate.

OCCURRENCE: Forms by the spontaneous dehydration of zinc-copper-melanterite in dry air.

DISCUSSION: Fits well into the group comprising chalcanthite, siderolite, etc. Being formed by nature only with the aid of man, it does not deserve a special name.

E. T. W.

Iron-copper-chalcanthite.

LARSEN AND GLENN, *op. cit.*, p. 228.

NAME: From the composition, containing *iron* partially replacing the *copper* in *chalcanthite*.

CHEMICAL PROPERTIES: *Formula*: $(\text{Fe}, \text{Cu})\text{O} \cdot \text{SO}_3 \cdot 5\text{H}_2\text{O}$ or $(\text{Fe}, \text{Cu}) [\text{SO}_4] \text{SO}_4$.

CRYSTALLOGRAPHIC AND OPTICAL PROPERTIES: System triclinic. Under the microscope pale green; $\alpha=1.517$, $\beta=1.536$, $\gamma=1.543$, $\gamma-\alpha=0.026$, all ± 0.003 . Biaxial with 2V moderate and sign —. Dispersion slight.

OCCURRENCE: Forms by the spontaneous dehydration of pisanite in dry air; most specimens labeled pisanite in collections prove to consist now of this material.

E. T. W.

Cobalt-chalcanthite.

LARSEN AND GLENN, *op. cit.*, p. 228.

NAME: From the composition, containing *cobalt* entirely replacing the copper of *chalcanthite*.

CHEMICAL PROPERTIES: *Formula*: $\text{CoO} \cdot \text{SO}_3 \cdot 5\text{H}_2\text{O}$ or $\text{Co} [\text{SO}_4] \text{SO}_4$. Only artificial material has been analyzed; it contains 35.9% H_2O , whereas the theory for the $5\text{H}_2\text{O}$ compound is 36.7%.

CRYSTALLOGRAPHIC AND OPTICAL PROPERTIES: Triclinic. Under the microscope rose pink; $\alpha=1.523-1.531$, $\beta=1.542-1.549$, $\gamma=1.547-1.552$, $\gamma-\alpha=0.024-0.021$. Biaxial with 2V medium, sign —. Dispersion not strong, pleochroism distinct.

OCCURRENCE: Forms by the spontaneous dehydration of bieberite and of other cobalt sulfates; material labeled bieberite in Col. Roebbling's collection has been found to consist largely of this compound.

E. T. W.

Manganese-chalcanthite.

LARSEN AND GLENN, *op. cit.*, p. 228.

NAME: From the composition, containing *manganese* entirely replacing the copper of *chalcanthite*.

CHEMICAL PROPERTIES: *Formula*: $\text{MnO} \cdot \text{SO}_3 \cdot 5\text{H}_2\text{O}$ or $\text{Mn} [\text{SO}_4] \text{SO}_4$. Only artificial material analyzed.

CRYSTALLOGRAPHIC AND OPTICAL PROPERTIES: System triclinic. Under the microscope pale pink; $\alpha=1.495$, $\beta=1.508$, $\gamma=1.514$, $\gamma-\alpha=0.019$, all ± 0.003 . Biaxial with 2V moderately large, sign —, dispersion slight.

OCCURRENCE: Obtained artificially by evaporation of a solution of manganous sulfate in a dessicator under reduced pressure at 23°.

E. T. W.

DISCREDITED SPECIES

FAMILY: SILICATES. DIVISION: R'' : R''' : H₂O = 8 : 7 : 5.

"Caryopilite" (Dana No. 508) = Bementite (No. 507).

J. T. PARDEE, E. S. LARSEN, JR. AND GEORGE STEIGER: Bementite and neotocite from western Washington, with conclusions as to the identity of bementite and caryopilite. *J. Wash. Acad. Sci.* 11(2), 25-32, 1921.

Discovery of a new occurrence of bementite led to comparison with related minerals, and "caryopilite" from Sweden was found to be optically identical with bementite. As the differences in composition between them are insufficient to maintain distinctness "caryopilite" should be dropped from the list of mineral species. As the properties of bementite and of neotocite have not been very fully recorded heretofore, they are tabulated here.

REDEFINITION OF SPECIES

Bementite

G. A. KOENIG, 1887. (Including "caryopilite," Hamberg, 1889.) Re-defined by PARDEE, LARSEN AND STEIGER, *op. cit.*, pp. 28-30.

CHEMICAL PROPERTIES: *Formula*: 8MnO : 7SiO₂ : 5H₂O or H₁₆Mn₈Si₇O₂₇, with slight replacement of manganese by iron, magnesium, and zinc. Theory, MnO 52.6, SiO₂ 39.1, H₂O, 8.3%.

The original analysis of bementite from Franklin Furnace by Koenig, a new one of material from the same locality by Steiger, that of the new Washington mineral, and the original one by Hamberg of "caryopilite," (on an admittedly unsatisfactory sample) all agree essentially. The average of the two new analyses, the only ones made on optically controlled material, is: SiO₂ 39.14, MnO 40.40, FeO 4.55, MgO 3.91, CaO 0.51, ZnO (abs. from Wash. material) 1.47, Al₂O₃ 1.14, Fe₂O₃ 0.36, H₂O-0.55, H₂O+7.96, sum 99.99%. Before the blowpipe it fuses readily to a black glass. It is decomposed by hot HCl with separation of granular SiO₂.

CRYSTALLOGRAPHIC AND OPTICAL PROPERTIES: System probably orthorhombic; cleavable in three directions, one perfect. Refractive indices: $\alpha = 1.603-1.624$, $\beta = 1.632-1.650$, $\gamma = 1.632-1.650$, $\gamma - \alpha = 0.023-0.029$. Biaxial negative with 2E very small. Orientation, α shown normal to plates; elongation accordingly +. The range in indices is obviously connected with the varying isomorphous replacements of manganese.

PHYSICAL PROPERTIES: Color gray, grayish brown or grayish yellow; darkens on weathering. Luster vitreous to pearly. Transparent in thin splinters. Structure, aggregates of small plates and fibers. Rather tough with splintery fracture. Hardness variable, from 6 in unaltered Washington material down to 2 in presumably somewhat altered Franklin Furnace material. Specific gravity 3.106 on fresh Washington material down to 2.83 on impure "caryopilite"; range in this as in optical properties connected with isomorphism.

OCCURRENCE: In all three regions—Franklin Furnace, N. J., Pajsberg, Sweden, and Olympic Mountains, Washington—occurs in metamorphosed manganiferous limestone.

DISCUSSION: The composition heretofore assumed for bementite is evidently incorrect, and the more complex one here assigned seems justified by the agreement of analyses on optically homogeneous material from widely separated localities. Two other minerals of somewhat similar properties are known, inesite and ectropite, but they are sufficiently different chemically and optically to show that they are distinct from bementite.

E. T. W.